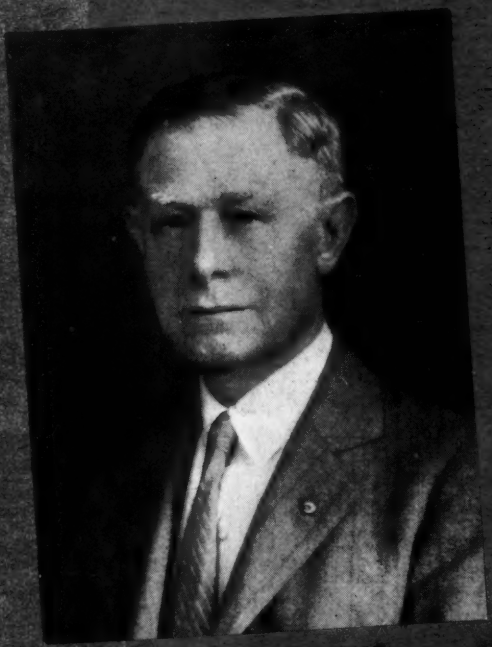
East Engin. Library
TS
672
A1
51

Ellis Baker

CONVENTION NUMBER

AMERICAN ELECTRO-PLATERS SOCIETY



PHILIP SIEVERING
Supreme President

THE MONTHLY REVIEW

JUNE, 1932

OFFICIAL PROGRAM

EXECUTIVE BOARD AND OFFICERS, 1931-1932

President

Philip Sievering.....Member Newark Branch
20 S. Crescent, Maplewood, N. J.

First Vice-President

Charles J. Griffin.....Member Rochester Branch
24 Carson Ave., Rochester, N. Y.

Second Vice-President

C. E. Marker.....Member Detroit Branch
13115 Meyers Road, Detroit, Michigan

Secretary-Treasurer

H. A. Gilbertson.....Member Chicago Branch
434 S. Wabash Ave., Chicago, Ill.

Editor

Wm. J. R. Kennedy.....Member Hartford-Connecticut Valley Branch
90 Maynard St., Springfield, Mass.

Past President

George Gehling.....Member Philadelphia Branch
5001 Tulip St., Philadelphia, Pa.

Associate Editors

Dr. Blum, Bureau of Standards, Wash., D. C.
O. E. Servis, Chicago Branch
F. C. Mesle, Rochester Branch
Dr. Graham, Philadelphia Branch
Tennant Elwin, Hartford Branch
John Feeley, Montreal Branch

CONTENTS — INDEX

	Page
Editorial—The 20th Annual Convention	3
Philadelphia Convention Committee	5
Convention Program	6
Ladies' Program	10
The Fellowship Club	11
Bureau of Education	13
The President's Letter	14
Our Research Department	15
Stout—The Significance of a Quantitative Analysis of a Plating Solution	17
Daw—Some Production Methods Used in Chromium Plating	23
Proctor—Chromium Plating in the Automotive Industry	28
Branch News	35
Applications, Elections, Etc.	43
Research Committee, Bureau of Education	45
Branch Directory	46

MONTHLY REVIEW

Published by the

American Electro-Platers Society

Publication and Editorial Office

90 Maynard St., Springfield, Mass.

VOL. XIX JUNE, 1932 No. 6

EDITORIAL

The 20th Annual Convention

When Past-President George Gehling stated at the Rochester Convention last year that the 1932 Convention of the Electro-Platers Society in Philadelphia would be original and distinctive, he meant just what he said. Since that time there has been considerable activity on the part of the Quaker city branch to make the Convention a complete success from an educational and social standpoint.

There will be a radical departure from former customs this year. The registration fee is only one dollar. This nominal amount is being charged because of the desire to curtail costs as much as possible.

No advertising program will be published as in other years. The MONTHLY REVIEW will carry in its pages a complete summary of the Convention proceedings. Educational sessions in the evening will be abandoned; in their place, however, will be entertainments, etc. At these social gatherings there is a splendid opportunity to get acquainted, many a plating problem has been solved on such an occasion as this when platers have a chance to talk "shop."

The program has been divided into three parts. Technical papers in charge of Dr. Lukens will consist of articles contributed by technical societies, etc.

Dr. A. K. Graham, who is one of the most familiar figures at all our platers' gatherings, has charge of the Industrial division. These papers will be presented by men engaged in industry and chemistry, also by associate members. The third group, the active members' division, will function as heretofore, presenting papers by the ac-

tive members of the Platers Society. Mr. Samuel T. Lunbeck has charge of this group. Mr. Lunbeck is prominently identified with the activities of the Philadelphia Branch and is foreman plater of a large manufacturing concern in Wilmington, Delaware.

Picnics and such events, usually a part of the afternoon Convention program, will be eliminated this year and will be substituted by plant visits.

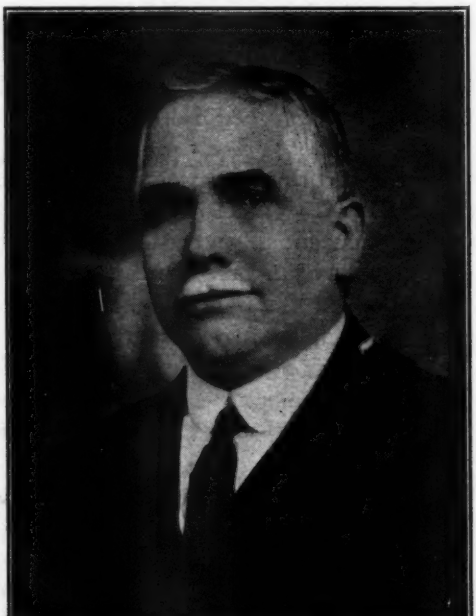
These are only a few of the highlights of the annual gatherings of the American electroplaters. In addition to these it is anticipated that business of great importance to the future growth of the Society will be transacted.

Every plater who can attend these meetings owes it to himself to be present. Owners and supervisors of manufacturing plants where metal finishing is done could very profitably afford to spend a few days in attending the sessions or at least insist that their foreman plater represent them.

Needless to say, the Committee has left nothing undone to make the 1932 Convention a success.

Remember the date—June 20 to 23 inclusive.

And the place, *Benjamin Franklin Hotel, Philadelphia.*



GEORGE GEHLING
Convention Director
MEMBER PHILADELPHIA BRANCH

Philadelphia Convention Committee

PAST PRESIDENT GEO. GEHLING, *Director*

Hotel

OTTO MOTT, 4620 Boudinot St., Philadelphia

ED. HOMAN, 1118 N. 28th St., Camden, N. J.

Registration

JOS. E. UNDERWOOD, 327 N. 10th St., Camden, N. J.

Plant Visits

JOS. L. DINAN & CO., 124 N. Pennock St., Highland Park, Penna.

Banquet Committee

HARRY SNYDER, 3942 N. Marshall St., Philadelphia

Ladies' Entertainment

J. J. BASCH, 310 Wesley Bldg., Philadelphia

Men's Entertainment

WARREN REYNOLDS, 807 Hellerman St., Philadelphia

Technical Educational Sessions

DR. HIRAM S. LUKENS, Harrison Laboratory,
University of Pennsylvania

Industrial Educational Sessions

DR. A. K. GRAHAM, Harrison Laboratory,
University of Pennsylvania

Active Members Educational Sessions

S. T. LUNBECK, 3304 Washington St., Wilmington, Del.

Headquarters and Registration will begin on Sunday, June 19, 2 p.m. on the mezzanine floor of the Benjamin Franklin Hotel, 9th and Chestnut Streets, Philadelphia.

The registrar will receive arriving members and guests, distribute badges and programs and give detailed information.

The registration fee will be one dollar per member or guest, and it will be necessary for all desiring to attend the meetings to be registered.

Through the courtesy of the International Fellowship Club, tickets for transportation to and from the OPEN HOUSE at the ELKS CLUB will be enclosed with the registration envelope.

Tickets for busses to the plant visits, the sightseeing tours and the banquet will be on sale at the registration desks and should be procured at the time of registration, so that proper arrangements can be made to take care of all those desiring to take advantage of these trips.

Program of the American Electro-Platers Society Convention

Monday, June 20

Morning Registration.

10:00 A.M. Business Session of the Supreme Society. President Philip Sievering presiding.

1:30 P.M. Educational Session, Dr. Hiram S. Lukens, University of Pennsylvania, Chairman.

1. "Electrodeposition of Tungsten from Alkaline Solutions" by Dr. Louis Kahlenberg and M. L. Holt of the University of Wisconsin.
2. "Peeling of Electrodeposited Nickel" by Dr. E. A. Vueillenmier of Dickinson College.
3. "Review of Recent Foreign Literature" by Dr. M. DeKay Thompson of the Massachusetts Institute of Technology.
4. "A Study of Base Metals in Industrial Chromium Plating Applications," by Lieut. Arthur Willink, of U. S. Arsenal, Frankford, Philadelphia.
5. "Free Cyanide in Brass Plating Baths," by Dr. L. C. Pan, New York University.
6. "The Decomposition of Cyanide Solutions," by R. M. Wick, Bureau of Standards, Washington, D. C.

8:00 P.M. The International Fellowship Club will be host to the delegates and guests.

Tuesday, June 21

9:00 A.M. Educational Session—Symposium on Zinc Plating, Dr. A. K. Graham, University of Pennsylvania, Chairman.

1. "Plating of Zinc Base Die Castings," by R. J. Wirshing, General Motors Company.
2. "Plating on Zinc," by W. M. Pierce, New Jersey Zinc Co.
3. "Electroplating Zinc on Aluminum," by Harold K. Work, Aluminum Company of America.
4. "Anodes for Zinc Plating," by Dr. A. K. Graham, University of Pennsylvania and Geo. B. Hogaboom, Hanson Van Winkle-Munning Co.
5. "Barrel Plating with Particular Reference to Optimum Loads and Costs," by Gustaf Soderberg, Udylite Company.
6. "Barrel Plating with Duo-Zinc Solution," by F. F. Oplinger, Roessler and Hasslacher Chemical Co.

1:30 P.M. Plant Visits:

1. General Electric Company.
2. R. C. A. Victor Company.
3. De Long Hook & Eye Co.

Tuesday night is left open for the members and guests, thereby giving them a better opportunity of enjoying their own little parties.

Wednesday, June 22

9:00 A.M. Educational Session, Mr. S. T. Lunbeck, Chairman.

1. "Anodic Deposition of Rubber," Albert Hirsch, Carey McFall Co., Philadelphia Branch.
2. "Finishing Steel Products by Use of Sand, Shavings, Soapsuds and Steel Balls," by Walter S. Barrows, Toronto Branch.
3. "Determination of Hydrogen Ion Concentration," by Dr. E. Sanigar, Philadelphia Branch.
4. "Alumilite," by H. Bengston and R. E. Pettit, Aluminum Colors, Inc.
5. "Developments in Metal Lacquers," by L. M. Hayden, Zapon Company.
6. "Recent Development in Lacquers," by Kenneth L. Longnecker, Stanley Chemical Company.

1:00 P.M. Plant Visits.

1. Naval Aircraft Factory, Philadelphia Navy Yard.
2. Philadelphia Storage Battery Company.
3. Royal Electrotype Co.
4. University Museum, University of Pennsylvania.

7:00 P.M. Annual Banquet, Crystal Ball Room, Benjamin Franklin Hotel, Mr. Harry Snyder, Chairman.

Thursday, June 23

9:00 A.M. Educational Session, Mr. S. T. Lunbeck, Chairman.

1. "Summary of Researches on Plating at the Bureau of Standards, Washington, D. C.," by Dr. Wm. Blum.
2. "Progress Report on Exposure Tests and Accelerated Tests of Plated Coatings," by Dr. William Blum, Bureau of Standards, Washington, D. C.
3. "Experiences in the Preparation of Specimens for Exposure Tests," by P. W. C. Strausser, Research Associate, Bureau of Standards, Washington, D. C.
4. Report of the Research Committee, Mr. J. Hay, Chairman.
5. Report of the Educational Committee, Mr. A. Hirsch, Chairman.

1:30 P.M. Business Session, Supreme President Philip Sievering presiding.

Business meeting followed by the election of officers for the ensuing year and the selection of the next convention city.

Ladies' Program

Monday, June 20

9:00 A.M. Registration on mezzanine floor.

2:00 P.M. Visit to the Curtis Publishing Co., the home of the *Ladies' Home Journal,* the *Saturday Evening Post* and the *Country Gentleman.*

8:00 P.M. The International Fellowship Club will be the host to the delegates and guests of the convention.

Tuesday, June 21

9:45 A.M. Sightseeing tour of the city, taking in the historical and traditional places of interest of the Quaker City.

1:30 P.M. Visit to the R. C. A. Victor Radio and Talking Machine Co., or the DeLong Hook & Eye Co.

Wednesday, June 22

9:45 A.M. Visit to the University Museum, University of Pennsylvania.

7:00 P.M. Annual Banquet in the Crystal Ball Room, Benjamin Franklin Hotel.

Thursday, June 23

A.M. Trips to Atlantic City, or boat trip down the Delaware Bay to Wilmington, Del.
(See Bulletin Board for time of these trips)

On the mezzanine floor an assembly room has been provided for the exclusive use of the ladies and which can be used for card parties and a meeting place, or for those who do not care to make the trips as scheduled.

Tickets for the busses to the plant visits and sightseeing tours and the Banquet will be on sale at the Registration desks and should be procured at time of registration so that proper arrangements can be made to take care of all those desiring to go on these trips.

The Fellowship Club

In July, 1925, in Montreal, a permanent society called the International Fellowship Club was organized with the following officers: *Chairman,* WILFRED S. MCKEON; *Secretary,* JOHN OBERENDER; *Vice-chairman,* W. W. WELLS. The plans and purposes of the organization are:

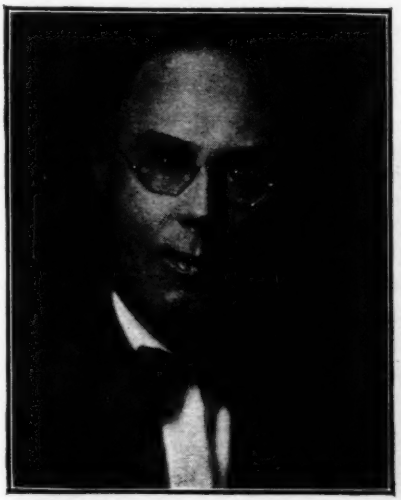
1. To have an organization interested primarily in the welfare of those who sell equipment and supplies to the electroplating and finishing trades.

2. To afford a means for the salesmen to get together and establish friendly intercourse for the purpose of better mutual understanding.

3. To establish a code of ethics for the best interests of the trade.

It was made clear that the new Club would not compete directly or indirectly with the old platers' organization. As Mr. McKeon stated to Charles H. Proctor, "The International Fellowship Club will not stand in the light or shadow of the American Electro-Platers Society."

Since that first gathering in Montreal regular meetings have been held at the annual conventions of the American Electro-Platers Society, at the January open meetings of the Chicago



ROBERT LEATHER
PRESIDENT

THOMAS A. TRUMBOUR
SECRETARY

Branch and the February open meetings of the New York Branch. The annual meetings have been held successively in Newark, Toledo, Toronto, Detroit, Washington and Rochester. The Club is now in its 8th year and flourishing. It has been highly successful in establishing its aims, and although much work still lies ahead, it has been a power for good in the industry.

No clearer exposition of the ideals of the International Fellowship Club can be expressed than by its code of ethics.

Code of Ethics

1. To be guided by the laws of honor and to compete with fairness and honesty.
2. To refrain from false references to competitors and their products or the circulation of harmful rumors concerning them.
3. To strive for a better knowledge of materials and processes so as more efficiently to advise his customers.
4. To promote the welfare of the industry.
5. To remember that information gained in the line of business is privileged and inviolable, not to be revealed except with full consent.
6. To assure the buyer full coöperation and the use of as limited amount of his time as the subject at issue will permit.
7. To coöperate in every way with those engaged in activities which will aid and improve the industry and to work with our competitors in all lawful ways to increase the efficiency and service to the industry as a whole.
8. To actually support the Federal Trade Commission in locating and prosecuting individuals guilty of improper practice.
9. To respect all obligations and to require that obligations to us and our companies be respected.
10. To adhere faithfully to the rules of conduct herein set forth, recognizing that a simple guide to right action is found in the practice of the Golden Rule.

The Fellowship Club has been a great help at all the social activities held during the convention.

At last year's convention in Rochester the club was particularly in evidence, both men and women, connected either directly or indirectly with this organization, brought new life and ideas into the

entertainment part of the annual meeting, which were highly appreciated.

We wish the International Fellowship Club every success as it endeavors to coöperate with the Philadelphia committee in catering to the social needs of the convention members.

BUREAU OF EDUCATION

ALBERT HIRSCH, *Chairman*

At this time we believe it is in order to review the work of the Bureau, together with a thought for the coming year.

An effort has been made to keep the membership familiar with the work of the Bureau. In this our editor has played an extraordinary part. Do all the members read the REVIEW? I wonder!

The sentiment of the Educational Session of the Rochester Convention left two things to be done, namely: (*a*) The organization of a sort of Chautauqua Bureau where speakers could be applied for. (*b*) Preparation of a booklet of direction for the analysis of plating solutions. In order to fulfil the requirements of (*a*) 180 circular letters were distributed through the nine district chairmen to manufacturers all over the country as a means of listing speakers for this work. Only five replies were received to the above queries, four negative and only one affirmative. The affirmative one was that of Dr. Soderberg from Udylite Process Co. (*b*) "An Elementary Course in Chemical Analysis of Plating Solutions," a detailed account of which was printed in the May issue of the REVIEW. Los Angeles and San Francisco branches organized platers' classes this year and used the course as prepared by the Bureau.

In observing the work of the Philadelphia branch—and the Philadelphia branch is not a backward branch—with reference to speakers at branch meetings and attendance at classes we find approximately 33% of the members go to hear the speakers and about 16% attend the classes. If this can be accepted as a criterion to go by, then the thought for the coming year might be: "How Can We Increase the Attendance at Both the Classes and Speaker Meeting?"

THE PRESIDENT'S LETTER

Upon the receipt of the June REVIEW the American Electro-Platers Society will have completed another decade in its history. The economic condition of the world during the past fiscal year has been such a severe test to all classes of business that the curtailment of their production has caused financial difficulties throughout the country affecting all classes of men whether executive or ordinary laborer. This condition then naturally affected all other organizations and our own Society was not excepted.

Your Supreme Officers and the various committees have tried to meet the condition confronting them and, although we may not have progressed as much as we have in other years, at least we have held our own and have not fallen back. Full details as to our standing in respect to membership and finances will be rendered at the Annual Convention.

Perhaps the most critical problem arising during the year was that which fell upon the research committee, whose funds were tied up through the closing of the bank in which they were deposited. Although the prospect of getting the money sometime in the near future seemed bright the research work could not be delayed and so the committee appealed to personal friends, to the Branches and to the subscribers for help during the emergency. How well they succeeded is now a matter of history which we may all be proud of. Those who have been so loyal and have given us so much aid when most needed at probably a great sacrifice to themselves will receive due recognition in my report to the convention.

How long the present condition will persist, I, of course, cannot say. We are all laboring under a strain but we must keep up our courage and hope for the best. I am appealing to all members to support your Branches by attending the meetings. Give them your moral and financial support so that our ideals may be carried out.

I am asking the members to acquaint their employers, firm or company of our Annual Convention to be held in Philadelphia, Pa., at the Franklin Hotel June 20 to 23 and to which they are cordially invited. There will be a number of interesting papers to be read and discussed. Scientific problems will be presented including the research work accomplished during the year.

Our Society, through the educational and research work in the science of electroplating, has won for itself a position of merit in the scientific world. We have accepted membership in the American Society for Testing Materials, and the Chemical Society and the Electrochemical Society have repeatedly invited our members to their meetings. Let us continue the good work and show to the world that the purpose for which this Society was founded has not been in vain but that we really have advanced the science of electroplating.

PHILIP SIEVERING, *Supreme President.*

OUR RESEARCH DEPARTMENT

To the Members and Officers of the American Electro-Platers Society:

It is now one year ago today that I had the pleasure of addressing you in the MONTHLY REVIEW of the June issue in 1931 and again it behooves me to say a few words to you for the benefit of the membership of this great Society of ours. Since our last convention at Rochester the Society has passed through one of the most trying times in its existence and although handicapped in every way has progressed and has kept on moving forward in the line of education; and has accomplished work in the line of research that no other society in the world can equal.

Our Society has just finished the work on research of electroplated coatings, of which all of you have been informed in the last REVIEW and it only remains now to see what the exposure test will actually bring forward. The results no doubt will be not only surprising to you but also to the metal industries at large. It is only with this in mind that I wish to say a few words regarding the support that has been given by industries of this country toward this worthy cause. I am not unmindful of the fact and do not forget that those who have given their financial support to this cause certainly have done so unselfishly and were very generous; but it has been a great disappointment to the writer not to receive the support from some of the largest manufacturers in the industry and no doubt they will gain more by our research work than any other individual of this Society. Let me say one word of thanks to the branches of the American Electro-Platers Society who so generously supported the Research Committee financially and I assure you, had it not been for your kind support, the research

work at the Bureau would not be in operation at the present time when the REVIEW goes to print.

There are members in our Society who not only supported our work but came forward and helped the Research Committee financially in the form of their own personal subscription to the fund. Others thought so much of the work that was carried on at the Bureau that they advanced money to the Research Committee so that this work of ours would not be interrupted.

For this reason I wish to appeal to the membership to change the constitution so it would be possible to assess the membership two dollars per year so we can maintain our research associate at the Bureau at the expense of the membership of the American Electro-Platers, for the benefit of all of us. The time has arrived where we cannot count on the manufacturers for any support along these lines. Let's give this matter our most serious thought and go to the Convention at Philadelphia and fight for the very ideal for which this Society was organized.

JACOB HAY, *Chairman Research Committee.*

H. A. GILBERTSON
Secretary-Treasurer
MEMBER CHICAGO BRANCH

THE SIGNIFICANCE OF A QUANTITATIVE ANALYSIS OF A PLATING SOLUTION

By Lawrence E. Stout, Ph.D.

Associate Professor of Chemistry, Washington University, Saint Louis, Missouri.

Read at the Saint Louis Annual Meeting, April 9, 1932

During the past few years the Bureau of Education of the American Electro-Platers Society has been very active in establishing chemical control classes in the various branches. As a result The Monthly Review contains from time to time a record of the progress made by some of the branches. The Saint Louis Branch was quite active in this matter a year ago and many of its members proved themselves to be quite capable analysts. In fact, with the large number of analytical schemes available today, there is little excuse for a plater being unable to test and analyze his own solutions if he is willing to invest a modest sum of money in standard chemical apparatus.

However, it is a long cry from an ability to analyze a plating bath to the attainment of true chemical control over the plating operation. The author feels that the latter is a matter which has been seriously overlooked in the past. A chemical analysis is not an end in itself, but is merely a method of "trouble shooting." The chemical analysis is of little or no value unless it falls into the hands of some man who possesses sufficient training and experience to utilize it. In fact, it may be said with absolute truth that an analysis is worth as much as the experience of the man into whose hands it happens to fall.

If a chemical analysis is ever to be significant, there are certain precautions which must be observed. In the first place the testing of a plating solution is a true quantitative analysis. The degree of accuracy required is not high, in most cases. In fact, it makes little difference whether the copper sulfate content of an acid copper bath is twenty-eight ounces per gallon or twenty-eight and one-half. The all important point is to discover whether the relative constituents of the bath are within the limits which experience has demonstrated to be good operating practice.

Any volumetric analysis involves certain general procedures. In the first place, a sample must be collected and a known volume set aside for analysis. Some suitable standard solution must be available. This standard solution must have a known reacting power with the bath constituent to be measured and there must be some indicator or other means of knowing when a definite chemical reac-

tion has been accomplished. Now, if the volume of the original sample treated is known and the quantity of standard solution required for the endpoint is measured, all the data necessary are at hand to calculate the concentration of the constituent in question in terms of ounces per gallon of solution.

The selecting of the sample must be carried out with due care. This sample must be representative of the entire body of solution which is under examination. If the liquid level has become lowered materially it is better to add water to the bath before stirring so that the sample as taken will represent the proper volume of liquid for the plating tank or container. The contents of the plating tank should be thoroughly mixed to minimize stratification errors before the sample is collected. All such adjustments must be made before the sample is taken so that the portion to be tested is a true cross-section of the entire contents of the tank.

If a plating bath contains much sediment or finely dispersed material that may become suspended easily it is a serious thing to stir up the contents of the bath at a time when plating must be done. It is well to take a sample of the bath at a time when the solution will stand idle for a number of hours before working again. Sampling at night or Saturday noon (before the week-end stand-by) is recommended.

Today many platers consider that an analysis should be made only when a bath is functioning badly. The results are then used to correct the composition of the solution. While this is good practice it is far better to make a periodic examination and analysis of the bath so that adjustments may be made before the composition is so out of balance that faulty work results. Such procedure will represent true chemical control of a solution, provided the plater has a working knowledge of the fundamental principles underlying the operation of the bath in question. Such chemical control should enable him to keep his solutions properly adjusted and in this way anticipate many of the troubles he has today.

It is true that many platers have become so skilled in the working of individual baths that they are usually able to turn out work of an acceptable quality. However, such operation leaves much to be desired and the personal equation becomes of abnormal magnitude. In addition to this, the plant manager has difficulty in allocating faulty work. The plater blames the buffer or polisher, and the polisher blames everyone else. In many cases, it is diffi-

cult to say just where the job was ruined. But, if the plater knows that his solutions are operating under chemical control, he has a strong argument to prove that the fault lies outside of his department.

Today other finishes and materials of construction are powerful competitors of the plating trade. These other finishes have their shortcomings but their production is under chemical control and the manufacturer is sure of uniformity in his finished product. Until the plating trade can establish such a guarantee of controlled uniformity it is at a serious disadvantage. It is true that there is a field for the very cheap grade or class of plating work. This type of plating serves as a surface decoration intended to last until the article leaves the hands of the shopkeeper. Unless the plating industry is to sink to the level of a mere decorative art, there must be a serious drive towards the production of work of a truly high quality. Many manufacturers of high grade plated products are loath to guarantee their wears because they have little assurance that their product will stand up. Uniform quality comes only with uniform operating conditions and this method of operation can be possible only when all the variables are under control. Plating plants that operate today under chemical control turn out a more uniform grade of work than was possible a few years ago under the old method of plating. It is the carelessly operated plant that destroys much of the good reputation that controlled plants could establish today.

The American Electro-Platers Society is to be commended for its drive towards standards for electroplated products. Such a standard of excellence does not preclude several grades of work. Sterling silver stands for a definite grade of product, 925 fine. U.S.P., C.P., A.S.T.M., etc., stand for certain definite quality merchandise and such designations dare not be used unless the product measures up to very definite specifications. It would be an excellent thing for the plating trade if some definite set of standards could be set up and enforced. Designating or grading work in this manner would enable the public to purchase plated wears as intelligently as it now buys other forms of merchandise.

Enforcement of such standards will involve the elimination or reorganization of many shops. Not long ago a certain company contracted to plate an order of brass articles according to the "U. S. Government Master Specifications for Plumbing Fixtures

and for Builders Hardware," which is one of the few adequate standardized specifications available today. The job was let to the lowest bidder and when a sample of the work was submitted for test, it had not received the specified quantity of either nickel or chromium. Moreover, the work had not been properly prepared for the plater, and in the buffing operation the nickel surface had been cut through in many places.

Without chemical control on the solution, it is difficult if not impossible for the plater to be sure that he is turning out his work up to a specified standard. Bath conditions can so affect the cathodic current efficiency that time of plating is no measure of the thickness of the coat. If chemical control of the process can be attained one big hazard in attaining the goal of standardized work will have been overcome.

At first sight, it would seem that true chemical control would necessitate a uniform composition for each type of plating bath. The selecting of the "best" formula for any given bath is next to impossible. Platers know that a formula may vary over comparatively wide limits and still give satisfactory performance. The all important problem in the formulation of the bath is the maintenance of a properly balanced solution. One individual chemical does not constitute a plating bath. A good plating bath is composed of a number of materials in solution, each proportioned so that its concentration is just adequate to fit into the general scheme of bath operation in a harmonious fashion.

For example, an acid copper bath consists of an aqueous solution of copper sulfate to which has been added a small quantity of sulfuric acid. The concentration of the copper sulfate may vary from 35 ounces per gallon to as little as 25 ounces provided the acid concentration is likewise varied over a range of from 8 to 5 ounces per gallon and the temperatures and current densities are properly adjusted.

When the apparent copper content of a bath becomes depleted, the current efficiency falls and excessive cathodic gassing is noted. Such a bath gives a low rate of deposition and the output per hour is decreased, if a definite thickness of deposit is specified. These symptoms do not always call for the addition of more copper sulfate to the solution. High acid concentrations in the bath decrease the apparent copper concentration by decreasing the copper ion concentration which is the active or apparent source of copper for

the plating operation. This shows that the same set of symptoms result from the same "disease" but that the latter may be caused by any one of a number of bath conditions. Only an analysis can point definitely to the real cause of the trouble. If the acid concentration is too high it means that the cathode efficiency has been high and the rate of anode corrosion low. Addition of more anode area may be more effective in producing a permanent "cure" (after the solution has been readjusted) than the regular additions and replenishing of the defaulting constituent.

On the other hand, high concentrations of copper sulfate in the bath cause irregular working and plating. Streaked, off-colored and treed deposits result. However, these same characteristics are observed from a solution whose copper sulfate content is correct but whose acidity is too low. The addition of sulfuric acid has only a 50% chance of correcting the defect.

A copper bath should be tested for its iron content as well as for its copper sulfate and its sulfuric acid concentrations. High iron contents of the bath cause streaked deposits, the streaks usually running perpendicular to the surface of the bath. Lower concentrations of iron in the bath cause off-colored deposits. These surfaces are decidedly pink when first removed from the bath, but rapidly change to a dull or light brown color. Usually these deposits containing iron are hard to buff. If color is important, the bath should contain less than 0.2 per cent iron per cent although considerably higher contents may be present without causing streaking and other troubles.

It is possible to get a good deposit without the aid of addition agents. However, many platers resort to additions of gelatine, glucose, dextrine, glue, etc., to insure smoothness to the deposits. The beneficial action of these brighteners is short-lived and excessive quantities introduce serious plating troubles. The writer feels that a solution that is properly formulated, carefully maintained, worked under correct current conditions and temperatures with anodes of the right proportions and placing needs no addition agents.

The handling of a cyanide copper bath is not quite so simple, in its formulation or maintenance. It consists of an aqueous solution of sodium cyanide and cuprous cyanide, the latter in the form of a complex chemical compound known as sodium cuprous cyanide. A moderate excess of free cyanide seems necessary for the proper

functioning of the bath but larger excesses are to be avoided. The free cyanide content can never be constant because sodium cyanide in solution undergoes anodic oxidation with the formation of sodium carbonate. This means that the cyanide contents of such a bath will become progressively lower and that the carbonate contents will increase until they become detrimental. Such an oxidation cycle disturbs the balance of the solution and only a chemical analysis or a happy guess can right the composition of the bath.

When the free cyanide of such a solution falls too low the bath changes from a faint cream color to assume a greenish blue tint. Bluish anode slimes also appear and the work comes from the bath spongy, pitted and off-colored. The mere "addition of more cyanide" is not always safe since too high concentrations of the substance likewise cause blistered and streaked deposits accompanied by an enormous decrease in the cathode current efficiency. These high free cyanide concentrations give symptoms almost identical with those of low copper content. Again the plater has a 50-50 chance of finding the cause of his plating troubles, without resorting to a chemical analysis. As the bath grows old in service its carbonate contents mount. At first no marked effect can be noted, but as the concentrations exceed a definite value throwing power of the bath decreases and the tendency to pit increases. Abnormal cathodic gassing is also noted. Only a chemical analysis can diagnose the cause of the trouble.

Similar observations might well be made regarding the functioning of a number of other baths. However, these data will appear in a more complete form in a series of articles soon to be published. These articles will contain complete directions for the analysis and will specify the operating limits for the concentration of each constituent part.

It is hoped that the members of the plating trade will accept the present day challenge for higher grade work by adopting chemical control of the process. Such control means more than the mere analysis of the solution. In the first place it demands that the plater know the desired analysis of his solution and that his bath be maintained at this value at all times. Control of the plating operation will be useless unless the surface is properly prepared for plating. The plater should refuse to accept work improperly prepared. If such practices are followed the plant manager has definite proof that this part of the plant is operating at a uniform

standard of excellence and his respect for plated wares will be justified. Controlled work means new outlets and increased production. Without it, continued encroachment by competing processes must be expected. In simple words, the "art" of plating must give way to the "science" of plating and the process can never be truly scientific unless the operator understands the relation between an analysis of a solution and its functioning as a plating bath.

SOME PRODUCTION METHODS USED IN CHROMIUM PLATING

By Burton G. Daw

Read at Saint Louis Branch Annual Meeting

In any discussion on chromium plating it is necessary to assume that the work to be chromium plated has been properly polished, in which case a grease stick or emery cake of a saponifiable nature is one of the very important factors. It is a very simple matter to fill the pores of a hot piece of metal with mineral oil or saponifiable greases, the saponifiable greases clean out much more readily and eliminate rejects to a large extent. In buffing, saponifiable compositions are also advisable. The nickel deposit should be heavy and soft. The nickel should be buffed with a saponifiable composition, and one with a pure lime base if possible, as it eliminates rejects caused by grey streaks and peeling.

Assuming that the polished work is properly plated, buffed and ready to chrome plate, we can consider some of the methods in use:

First: After the nickel has been buffed it is wiped carefully with a dry cloth and then hung in the chrome plating tank. Before the work is hung in the tank the voltage should be reduced to around 2 to 2½, about a volt below the regular plating voltage. This causes a small amount of bubbles to arise from the work, and after it has been in there a few moments the voltage is increased until the correct current density for a bright plate is reached. The work is then allowed to remain at this voltage until it is properly plated. This method works out very satisfactorily on some big production jobs where the work rod is completely loaded at the lower voltage, and then plated as stated above. Then the entire load is removed after the current has been cut off. With this method it is possible to load tanks to a full capacity on certain classes of work.

Second: This probably is the most common method at this time;

that is, cleaning the nickel with an alkali cleaner in conjunction with an electric cleaner and running through cold water rinses, muriatic acid, cold water, and then into the chrome at the plating voltage, or at a voltage higher than the ordinary plating voltage, with the idea of a heavy current density to throw into recesses and act as a strike plate, reducing the voltage to the normal plating voltage for the required deposit. This method works out very satisfactorily when plating one piece at a time. When the voltage is set at the plating voltage it is also practical to have four or five racks of work in the tank at a time, removing one and replacing it with another at once, thus keeping the work rod full. One of the talking points for this method is the prevention of dirt, grease and other foreign substances from getting into the chrome tank. However, we have seen the first method employed over a period of three years in production, without the necessity of pouring the solution down the sewer, so it is questionable whether there is any great saving on that score. I might say that the solution that has been in operation for three years did not show any appreciable increase in trivalent chromium during that length of time.

Third: This method was employed by one of the large automobile companies very satisfactorily on radiator shells, and without a doubt it has some very distinct advantages on certain types of work. The work to be plated is cleaned as in the second method, but instead of being hung into the chromium plating tank and then connected up to the cathode, it is attached to a flexible cable which is the cathode connection, and then slowly lowered into the tank with the plating voltage turned on. This method is supposed to have the advantage of throwing into recesses easier and better than the other two, the theory being that the plate is deposited instantly as the work goes into the solution, and for that reason there is no chance for the surface to become passive or insulated. After the piece is entirely submerged it is allowed to plate for the required length of time at the plating voltage. This method undoubtedly has applications in a great many places where at present it is not being used. In all probabilities the labor cost would be higher than the other two methods, but it might be possible to eliminate rejects to a certain extent. On some of the fancy serving trays with sand-blast background, it has been found that it is nearly impossible to obtain a uniform bright deposit without a combination of methods Nos. 1 and 2. On that particular class of work the work is cleaned

and then hung in the chrome tank at a cleaning voltage before it is plated.

The above methods can be employed in practically any chromium solution, depending upon the class of work and facilities for control.

One concern who has plated a great many plug gauges with a low metallic content solution found that by raising and lowering the anodes around the gauges it was possible by experience to determine the exact relation that the anodes should bear to the gauges to enable them to plate a uniform deposit. The hydrogen bubbles thrown off of the gauges would act as a resistance in the solution, so that the top of the gauge had practically the same thickness of deposit as that at the bottom.

A large percentage of chrome plating is done on buffed nickel, but there is a very large field for chromium plating pieces that have been nickel-plated in barrel platers, or that have been nickel-plated in still tanks and ball burnished. This type of plating has the advantage of being low in price, and on many jobs very satisfactory. It is practical on some production jobs to use cadmium as a brightener in barrel platers before chromium plating. This does not mean that a perfect job is the result. Some of the most successful businesses have been built up on making items that were low in price, but had the looks of real value.

On one particular job where there was an assembly of several springs it was found too expensive to chrome plate each spring separately. These springs were all plated in a plating barrel with a cadmium brightener. When the springs were assembled and plated in an ordinary way, the results were not uniform, as the springs were different in size, and some would burn and others would not be plated. In an endeavor to overcome this difficulty a low metallic content was used with about one two-hundredth part sulphate, the temperature was run around 135 degrees, and this particular assembly was plated for four seconds. If it was left in longer than that it would burn, and if it was left in shorter than that it wasn't satisfactorily plated. The result was a job satisfactory for that particular item at a low unit cost, but not what would be termed "100% perfect job."

A better chromium plating job is had on barrel plated nickel when the chromium is applied within a short while after the work comes out of the nickel barrel. One of the very important things

in chrome plating nickel that comes from a barrel plater or a burnisher is to put it through a muriatic acid dip, cold water rinse prior to drying. On barrel plated work it seems to work better to go directly from the barrel plater into a dilute muriatic acid before rinsing in cold water. This has a tendency to eliminate stains and nickel oxides, the result is fewer rejects.

Occasionally we all get an opportunity to shoot trouble on solutions of our own or somebody else's. This occasion came up, and we found that the work was coming out with iridescent marks on it and grey spots which would make one believe that the solution was low in sulphate content. There had been no chromic acid or sulphuric acid added to the solution since the solution had last been used satisfactorily. The solution had become unusually hot and had evaporated about 25% of its volume. This had been replaced with water and dummy cathodes had been put in the solution, and the solution run with a high current density, but the solution did not come back. On the outside of the exhaust fan there were no signs to show that sulphuric acid or solution had been carried out in the form of spray. We had been told that it was impossible to boil sulphuric acid out of a chromium bath, but to make this work it was necessary to add a large amount of sulphuric acid. Then where did the sulphuric acid go? It couldn't be dragged out because the solution had not been used.

After two or three years we were fortunate enough to discuss the matter with Dr. Stout who suggested that the lead absorbed the sulphuric acid at high temperatures. This in a way is borne out when we consider that we can put a lead cold water coil and a lead steam coil in a chrome tank and find that the lead steam coil will deteriorate or wear out in a short length of time, while the cold water coil seems to be perfectly good. It is evident that the excessive heat in the steam coil causes it to absorb some deteriorating properties from the chromium solution. According to Dr. Stout the sulphuric acid is what is absorbed. This may explain why in chromium plating we can go along very nicely and all of a sudden the solution goes dead, especially when the solution is run at high temperature. This doesn't mean that it is advisable to add sulphuric acid every time a chrome solution refuses to work.

In the early days it was thought that it was impossible to satisfactorily chrome plate with a moving cathode or agitation. The demand for big production, however, brought out the necessity of

conveyor equipment in chrome tanks. Past experience with nickel and copper had led us to believe that, when we moved the cathodes, we could expect to increase the current density somewhat without the danger of burning. When a conveyor with a speed of 6 ft. per minute was used on a chrome tank we were surprised to find that it was possible to reduce the voltage and increase the throwing power while there was no particular advantage in increasing the voltage. In chromium with a moving cathode the work came out more satisfactory with a lower voltage, and the product was more uniform. The result was fewer rejects and a more uniform product at a lower plating cost. The remarkable thing about it was that it was possible to plate the highest quality of work such as serving trays, toaster parts and things like that in a solution which was built up for a cheap production job, proving that practically any chromium solution will give satisfactory results if properly handled.

Another advantage of a moving cathode in chromium is that by reducing the voltage and using a lower current density the tendency to peel is reduced, and often overcome, although the throwing power is improved. Strange as it may seem in actual production a Richards Rotary Plater having a cathode speed of seven and one-half feet per minute gives better chrome plating and a more uniform product than by using an ordinary still tank. The advantage in full automatic conveyors and rotary platers with fast moving cathodes for chromium plating is not so much in the labor saved as the money saved through the reduction of rejects. A uniform plating time in chromium is one of the big assets of a full automatic conveyor. A variation of one-half minute either way in chromium plating may cause a reject.

Possibly you gentlemen have had some experience along the following lines, and if so it might be of mutual benefit for you to tell us of your experiences: A capable plater who has several types of nickel solutions told me that he never was troubled with peeling underneath chromium if after he had buffed his copper and had run it through a cleaner, cold water rinse, muriatic acid, and cold water, he then gave it a momentary strike in a hot cyanide copper solution, not enough to spoil the color, just a quick strike from there into cold water and then into the nickel.

CHROMIUM PLATING IN THE AUTOMOTIVE INDUSTRY

DEPOSITION OF CHROMIUM UPON ARTICLES MADE FROM SHEET ZINC IN THE AUTOMOTIVE PRODUCTS INDUSTRY

By Charles H. Proctor

Read before Chicago Branch Annual Meeting, 1932

This paper I have written is not a subject for today—it is looking into the future when this great industrial depression has passed away, the cloud of adversity gone and the clear blue sky and the sunshine of prosperity is again with us. We have had such industrial depressions before, we shall have them again. Why, we do not know. They are like human diseases that come and go. Forty years or more ago the Republican leaders would prophesy entire disaster to the country if a Democratic president became elected and for months before election, and sometimes a year afterwards, we did have industrial reverses because we lacked the faith of our fathers to cut and hew our way through the forests of depression. Fortunately for the Democratic Party and its adherents, we are living under a strictly Republican administration or there would be the devil to pay in future Democratic elections.

In the beginning of President Wilson's administration business conditions were on a parallel with conditions today. The Great War came along and then the faith and patriotism that we then lacked became inspired because we believed that the cause we fought for was a just cause and our country was at stake.

We are now living under a great Republican administration. President Hoover is as good and as ideal a president as ever sat in a president's chair in these United States. If he could end this great industrial condition by his own personal efforts it would have ended a year ago, but he knows he cannot do this without the help of all the people. We must not only have faith to overcome our problems, but the master will to solve them. Supply and demand is the real problem. No demand, no necessity of supply. We have the money, billions of it, tied up in the banks of this country. Let us call off the strike of depression and start the real purpose of money as a medium of exchange to purchase goods that everyone needs by spending it. The coming fall months, I believe, will see the end of the depression and prosperity will return again greater than ever.

Looking forward to the future prosperity and the increase in prices of commodities that will eventually ensue in all industries,

as well as the metal and metal fabricating industries of which you and I and all members of our Society are an integral part, the time is coming when all the common metals of commerce will advance in price—steel, copper, zinc, and their alloys such as brass and bronze and aluminum and also the precious metals. So it will be necessary to substitute zinc again wherever possible, as we had to do in 1890 when a great French syndicate cornered the copper markets of the world and prices became so prohibitive it could not be used, so zinc in the form of malleable sheets was used in the manufacture of a thousand articles previously made from copper and brass until the reaction came. This gave a great impetus to the electroplating industry, which has increased year by year until it has become an integral part of the great metal fabricating industry of these United States and Canada.

So we come to zinc, one of the metals that is used on a tremendous scale in the protection of ferrous metals from atmospheric corrosion, as a galvanized surface on steel and iron and then there are the millions of die castings made almost every month which are composed essentially of zinc.

I am going to give you a short history of zinc. It is an old metal as history goes, as zinc, like bronze, was known to the people of ancient days, and goes back beyond the days recorded by history. Archaeology has given us authentic and indisputable evidences that many ancient peoples were familiar with the enduring qualities of zinc and made use of it for their idols, temples and other sacred articles which they wished to preserve for all time. The figure of an idol dug up in a prehistoric Dacian settlement in Transylvania was found, on analysis, to contain 87.5 per cent zinc. In the ruins of Cameros, destroyed 500 B.C., bracelets and other ornaments filled with zinc were unearthed.

In the ruins of Pompeii, the ancient Italian city destroyed by Vesuvius in 79 A.D., a fountain covered with zinc was found. According to Kasurim, the Chinese historian known as the Pliny of the Orient, zinc was produced and used much earlier.

According to the most authentic records, knowledge of the art of smelting zinc ore was brought from China to England towards the middle of the 18th century and from there to the United States. We do not, however, have to depend upon the archaeological discoveries of the ancient uses of zinc. Every metallurgist, chemist and American electroplater does, or should, know the great com-

mercial value of zinc as a protecting agent for iron and steel when properly applied to such metals.

When the United States took over the French concessions for Panama Canal, practically the only material that was still intact and usable was the sheet metal—zinc—on the buildings erected by the French company. Even the torrid weather of the humid salt-laden air of the tropics had no deteriorating effect on zinc. Many of the most famous public buildings in Europe are roofed with rustless zinc. Among these may be mentioned the Canterbury Cathedral, England; the Gare Du Nord, Brussels; the Church of St. Clotilde, Paris; the Church of St. Bartholomew, Liege; the Bourse, Brussels, and many other equally well-known cathedrals, theatres and public buildings. The dome of the National Capitol in Washington is covered with a zinc paint as a protection against rust.

Is it any wonder that zinc predominates as a rust protective factor and cadmium is a secondary consideration?

Looking forward, then, as I have outlined to you, this automobile hub cap which I present to you is made from sheet zinc and steel. The housing is of cold rolled steel, rust-proofed by zinc plating in a "Duozinc Plating Solution." The polished front made from sheet zinc, nickel and chromium plated, and then the zinc disc so treated is closed over the steel housing by the aid of power presses, making a perfectly finished product. It was intended at first to use a copper deposit as a basic deposit before nickel and chromium plating, but "process engineers" in one of the great automobile plants have decided that copper should not be applied to a zinc die casting or articles made from zinc, previous to nickel-plating, etc. Why? Process engineers are sometimes radically wrong and their mistakes are costly ones. When the automobile steel rim manufacturers had to change from zinc plating the rims, previously zinc plated in Duozinc solutions, to a rustproof black rim, the process engineers advocated a boiling process for the finish. Phosphoric acid and manganese phosphate were used in the aqueous solution for the production of the black basic finish, which was finally black enameled for final finish and protection.

It cost two firms two hundred and fifty thousand dollars to discard their zinc plating equipment and install the boiling process and then they were never able to produce a rustproof rim equal to a competitor. The independent firm was at first greatly influenced

to follow their two competitors. I had, however, developed a process for rustproof steel black rims by first zinc plating for half the previous time period, then by the aid of a solution consisting of sodium hydroxide and antimony oxide in water heated to 160 deg. Fahr., a black coating resulted which made the rust resistance of the preliminary deposit of zinc more than double its previous resistance under the 20 per cent salt spray test. A final black enamel coating was applied for finish. The entire process became automatic in production.

The president of the independent firm finally decided that the method advocated to him was the correct one. They retained their zinc plating unit intact, with a resulting saving of their two hundred and fifty thousand dollars, which went into the pockets of the stockholders. I talked with the president of the firm in question on my last middle western trip late in May and he said, in discussing the results obtained, that "you were correct" and "out of five million auto rims we have finished by your method only 250 rims have been rejected for defective finish, and our black rims never rust."

Process engineers are an asset to any large organization, but sometimes their vision is dimmed to such an extent by their own personal ideas they become a great liability.

The procedure followed in finishing this automobile hub cap, presented to you as an idea for the future, is as follows when necessity may arise to utilize zinc due to the higher cost of brass, which may result in the near future when present depressed conditions are reversed.

When the subject was first brought to the attention of the author, I outlined to our "Research Plating Department" the procedure to follow in finishing the sheet zinc to approximate the sample presented to you here. It is, however, to be understood that the polishing of the sheet zinc previous to plating is to be in accordance with standard practice for sheet zinc or die castings.

The method is as follows:

(*a*) Combination Cleansing and Copper Plating Solution—

Part No. 1

Water	½ gallon
Trisodium phosphate	4 ounces
Potassium hydroxide	½ ounce

Part No. 2

Water	½ gallon
Sodium cyanide	1½ ounces
Copper cyanide	1 ounce
Sodium hyposulphite	1/50 ounce

Operating Conditions

Anodes	Copper
Temperature	75°—80° C.
Cathode current density	70 A/SF
Time	1, 2 and 3 minutes

The pieces were then plated in the following nickel solution—(*b*)

Water	1 gallon
Nickel sulphate	12 ounces
Nickel chloride	2 ounces
Boric acid	2 ounces
Magnesium sulphate	12 ounces

The pH of this solution, as made up, was 6.9. This was reduced to 6.0 by adding citric acid.

Operating Conditions

Anodes	Electrolytic Nickel
Temperature	68-86°F. (20-30°C.)
Ratio anode to cathode area	2 to 1
Cathode current density	8 to 9 A/SF
Anode current density	4 to 4.5 A/SF
E.M.F.	3 to 6 volts
Time	6 and 8 minutes

There was no noticeable difference between the 6 and 8 minute nickel plate.

The nickel-plated pieces which had been plated for 2 and 3 minutes in the copper solution were not buffed to a lustre finish. After buffing the samples were given a mild cleansing and weak hydrochloric acid dip, water rinsed and then plated in the following chromic acid solution. The cleansing, however, is not absolutely necessary if the nickel is buffed clean.

Water	1 gallon
Chromic acid	25 ounces
Zinc sulphate ($7H_2$)	¾ ounce

Operating Conditions

Temperature	110°F.
Anodes	Lead
Ratio anode to cathode surface	2 to 1
Cathode current density	140 A/SF
E.M.F.	3 to 5 volts
Anode current density	70 A/SF
Time	3 minutes

The resulting plate was bright and adherent. The samples of sheet zinc so plated withstood bending at right angles until the zinc was broken in two without any separation of the plated deposits.

When the data as outlined was presented to our customer he was greatly interested to know that they would meet with very little difficulty in producing automobile hub caps from sheet zinc, etc., finally finished in chromium, if they had to do so.

But the engineers of the automobile firm had decided that a preliminary copper deposit was of no value in nickel-plating sheet zinc, so the deposit would have to be eliminated to conform with engineering specifications. I am wondering what would happen in the sheet zinc plating industry in La Salle and Peru, Ill., if the customers of these firms finally decided that the preliminary copper deposit now applied to the sheet zinc in their combination, copper plating and cleansing methods, was ordered eliminated. It is a question whether the splendid deposits of copper, nickel and chromium as now applied and so tenaciously adherent would be as they are if the copper deposit was eliminated. This is a question mark.

The sample presented to you was not plated with a preliminary copper deposit, so the procedure in preparing the zinc deposit for the nickel and chromium deposit approximated the following:

Temperature, current control, etc., approximated the details previously given.

Procedure without preliminary copper plating the sheet zinc.

(*a*) Cleansing solution

Water	1 gallon
Trisodium phosphate	3 ounces
Sodium cyanide (96-98%)	1/3 ounce

Temperature: 180 deg. Fahr. Time of immersion—one minute or more.

(*b*) Wash the articles thoroughly in cold water.

(*c*) Acid Treatment

Water	1 gallon
Commercial hydrofluoric acid	3 ounces

Immerse for a second or two, then rewash in cold water and preliminary nickel-plate in the following solution:

(*d*)

Water	1 gallon
Single nickel salts	6 ounces
Double nickel salts	2 ounces
Nickel chloride	2 ounces
Sodium citrate	4 ounces

Anodes: cast nickel, 99%. Time of plating, two minutes, at 4 to 5 volts. From the preliminary or strike nickel solution, nickel-plate for a minimum of five to eight minutes in the following standard nickel solution:

(*e*)

Water	1 gallon
Single nickel salts	32 ounces
Nickel chloride	2 ounces
Acetic acid 50%	1 ounce

Anodes: Nickel, 99% plus, rolled or cast. Temperature: 100 to 110 deg. Fahr. Voltage, 4 to 5.

After nickel-plating as outlined, buff the articles to a lustre, finish under usual buffing procedure, then chromium plate direct without any further cleansing.

(*f*) Chromium solution

Any solution approximating 25 to 32 ounces per gallon of chromic acid can be used for final chromium plating. The solution previously mentioned has given wonderful results as many of our members can testify. The writer's own patented chromium solution can also be used with the same ideal results.

The sample, however, was chromium plated in the following solution because at the time of plating no other solution was available:

Water	1 gallon
Chromic acid	32 ounces
Sodium sulphate anhydrous	7/10 ounce

Voltage, 6. Amperage 100 per S F A. Temperature, 100 deg. Fahr. No final buffing necessary.

BRANCH NEWS

NEW OFFICERS OF THE DAYTON BRANCH

President
THOS. CUSICK
1255 Arbor Avenue
Dayton, Ohio

Vice-President
CHAS. ABBOTT, JR.
206 Pleasant Street
Dayton, Ohio

Secretary-Treasurer
WARD B. PROTSMAN
141 Westwood Avenue
Dayton, Ohio

Librarian
IRA VAN PELT
Box 158
Fairfield, Ohio

Board of Managers
MR. HARTER
MR. FRAINE
MR. SUMAN

Delegates to Convention
MR. VAN DERAU
MR. HOHMAN
MR. FRAINE

Alternates
MR. SMITH
MR. FISHER
MR. CUSICK

Auditing Committee
MR. HOHMAN
MR. CUSICK
MR. FOLTZ

NEW OFFICERS OF THE GRAND RAPIDS BRANCH

President
CHAS. WHALLEY
931 Pine Avenue, N. W.
Grand Rapids, Mich.

Vice-President
JOHN CARLSON
2045 Stafford Avenue, S. W.
Grand Rapids, Mich.

Secretary-Treasurer
JACOB VAN DYKE
1361 Union Avenue, N. E.
Grand Rapids, Mich.

Librarian
WM. EARL STADEL
415 Oakdale Street, S. E.
Grand Rapids, Mich.

Board of Managers
R. J. MCMEEKEN
JOHN RAVEN
THOS. OATES

The new officers of the Electrodeposition Division elected at the recent annual convention of The Electrochemical Society are:

CHAS. H. ELDRIDGE, Detroit, Mich., *Chairman.*
O. P. WATTS, Madison, Wis., *Vice-chairman.*
ARTHUR H. KOPP, Metropolitan Museum of Art, New York City, *Secretary-Treasurer.*

LOS ANGELES BRANCH

The regular monthly meeting of the Los Angeles Branch was held the second Wednesday of April, 1932, at the Chamber of Commerce Building. The meeting was called to order by President E. W. Francis. The meeting was well attended and everyone including the visitors seemed to enjoy the meeting as well as deriving some valuable information. Communications were read and the bills were ordered paid.

Mr. Ed Cushing, 917 Cole Avenue, Hollywood, Cal., was initiated to the branch. The report of the Annual Banquet was made by Benj. Foss, who suggested the net receipts be deposited in the Branch's fund. Mr. Foss and the committee were awarded a vote of thanks and discharged.

A committee of ten members was appointed to hold a meeting at the Rosslyn Hotel with the purpose of determining meeting there in the future, as well as devising a way to collect dues from a list of delinquents.

Mr. Elmer W. Woodmansee, a member of Detroit Branch, was present and expressed his desire to stay in Los Angeles if he is able to secure employment. Mr. Lee Davis and Mr. Geo. Dempsey, an absentee, were also present.

The Librarian, Mr. Earl Coffin, arranged a nice program aside from the few questions which he found in the red box. Earl read the complete schedule of formulas of plating solution used in plating 6000 specimens and distributed at various parts of the United States by the Bureau of Standards at Washington, D. C. The other subjects were "Plating of Stainless Steel" and "Mr. Proctor's letter on the Chromium Situation."

The questions were as follows:

Question—From my observation chromium-plated die castings exposed on automobiles blister eventually. Is it true? If so can the trouble be remedied?

Answer—Blisters are caused by uncleanliness. Work should be perfectly cleaned in mild cleaner at 200° F. and then bright dipped before plating.

Question—Which of the two gold salts is cheaper, gold cyanide or gold chloride?

Answer—Gold cyanide.

Question—Has anyone had experience with adding nitric acid to a nickel solution to prevent pitting?

Answer—No. It was suggested to make some tests and report result at the next meeting.

Question—Can stainless steel be plated successfully?

Answer—Yes. There will be a paper on this subject in a few minutes.

Question—What are other branches doing with their delinquent members? Are they living up to the constitution or are they giving leniency?

Answer—I believe the branches should exchange their ideas on account of present conditions with other branches on this point which is a very, very vitally important one to the entire A. E. Society. Branches please answer.

There being no further business the meeting adjourned at 10 p.m.

M. D. Rynkofs, *Secretary-Treasurer.*

REPORT FROM LOS ANGELES CHEMISTRY CLASS
DISTRICT No. 9

The Los Angeles Branch's Class is sponsored by the Los Angeles Board of Education and meets every Tuesday and Thursday, 7 to 9 p.m., at Polytechnic High School during the school term. The teacher is A. A. Bissiri, a member of the Los Angeles Branch A. E. S.

The class, like all others, started out large in 1930 with about forty, has an attendance of about 20 now. It used the regular chemistry textbook for elementary studies, then followed with the "Principles of Electroplating" by Blum and Hogaboom.

The class was taught, first, elementary principles and the care in the use of various apparatus in connection with any plating solution analysis.

Second, the care and accuracy in making up new plating solutions.

Third, composing and preparing standard solutions and ascertaining their factors, etc.

Fourth, hydrogen ion concentration.

Fifth, the weight determination of metal in the various salts.

Sixth, determination of purity of precious metals.

And last, the study of corrosion.

Recently, the Los Angeles Branch students purchased fifteen books titled "The Elementary Course in Chemical Education" as prepared by the A. E S. Bureau of Education, and find it very valuable to any plater who wants to make a quick analysis of his solution. It is a booklet every member of the Society should have in his plating room.

A word about San Francisco, which makes up the other half of this 9th District. The Golden Gate City is located some 500 miles from Los Angeles, and it is utterly impossible for the Branch Representative of the 9th District to get in personal contact with the members of that city. The writer has mailed literature, etc., and requested a report but presumed the report is sent directly to the Chairman of the Bureau of Education at Philadelphia.

A suggestion is made, owing to the great distance between these two branches, that San Francisco be made a separate district to care for itself as well as any other future branches in the northern part of the Pacific Coast. M. D. RYNKOFS, *Branch Representative,* District No. 9.

HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford-Connecticut Valley Branch held their regular monthly meeting on Monday evening, April 25, at the Springfield Chamber of Commerce, Springfield, Mass.

The meeting was called to order at 8:15 p.m. with President Fleming in the chair. Minutes of the previous meeting were read and accepted. One member, Mr. Norman Mosesian, was elected to active membership, and one active member, Mr. Moorad Mosesian, was granted a transfer to the Boston Branch. One communication was read. It was voted to rescind the vote of the previous meeting whereby we had voted to hold our annual Educational

Session and Banquet on May 14, 1932, at the Hotel Bond, Hartford, Conn. The various committees were discharged with a vote of thanks.

A committee of three, consisting of Mr. Frank Clark, Mr. Joseph St. Pierre and Mr. Joseph Beloin, were nominated to secure names for office nominations to be held on our next meeting in Hartford on May 23.

There being no further business, also no speaker for the evening, we adjourned at 10:30 p.m.

V. E. GRANT, *Secretary.*

PROVIDENCE-ATTLEBORO BRANCH

The April 15 meeting was held at the Jesse Metcalf Hall in Brown University, and was a lecture and demonstration on Rhodium deposition, by Mr. Lionel Cinamon, Ch. E. of the Sigmund-Cohn Co.

Mr. Cinamon very nicely and clearly described the factors governing the successful operation of the sulphate solution that was first on the market, and also the phosphate solution that has more recently appeared. He brought out the points in favor of and against each solution, and it seemed to the writer that the phosphate solution, though calling for a first cost of about double that of the sulphate, had the advantage in being applicable to a wider range of metals to be plated and in the Providence district that is important.

Mr. Cinamon plated a number of pieces or strips for comparison, and also passed out to the audience collar buttons and tie holders finished with Rhodium.

There were over 75 present (estimated) and the audience seemed keenly interested, indicating the general interest at present in this district in Rhodium.

The credit is due Dr. Strachen for arranging all details of the meeting.

JOHN ANDREWS, *Secretary.*

MILWAUKEE BRANCH

The educational meeting and smoker held on April 30 was a tremendous success, those that did not attend missed the treat of their lives, those that attended will be back next year. We had visitors from Detroit, St. Louis, Chicago, Racine, Kenosha, Beaver Dam and Fond du Lac, the attendance was the largest Milwaukee Branch has had at a smoker. The educational meeting started promptly at 8 o'clock but the visitors kept coming till 9 o'clock when the sign "Standing Room Only" was hung on the entrance door. The educational program was in charge of Librarian Henry Binder, the program was very interesting and kept the crowd on tiptoe from start to finish.

Educational program as follows:

Jos. H. HOEFER—Crown Rheostat Co., Chicago, Ill.
"Plating Costs"

GUSTAV SODERBERG—Udylite Process Co., Detroit, Mich.
"Some Experiences in the Servicing of Plating Solutions"

RAY GOODSELL—Racine Plating Works, Racine, Wis.
"Nickel Plating"

H. A. GILBERTSON—Supreme Sec'y A. E. S.
"Rhodium Plating"

LESLIE C. BORCHERT—General Spring Bumper Corp., Chicago, Ill.
"A bent cathode test—for determining throwing power and Cadmium content of nickel plating solutions—using Cadmium as a brightener."

EDWIN M. BAKER and P. J. MERKUS—Ann Arbor, University of Michigan.
"Lead and Lead Antimony Anodes for Chromium Plating"

After the educational program, the crowd made a grand rush for the lunch and refreshments, this gave the boys a good chance to get acquainted and the spirit of good fellowship prevailed. The entertainment in charge of Pat Sheehan kept the boys in good humor and will be remembered as an entertainment de luxe by all of our guests, twenty high- and low-class vaudeville acts kept the crowd till the small hours of morning, some of the guests missed their trains and stayed till Sunday noon. It was the unanimous opinion of those attending that an educational meeting and smoker gets a better attendance in our city than a meeting followed by banquet as all of the boys had a wonderful time.

During the course of the evening our guest and pal, Mr. F. E. Colien of the Vocational School and instructor of the chemists class just closed, was called on for a few remarks. He thanked the members of the class for their faithfulness and also thanked the boys for the gift presented by the class.

Milwaukee Branch wants to thank all those that appeared on the educational and entertainment program for they helped make this affair a grand success.

The regular meeting of Milwaukee Branch A. E. S. was held May 12, 1932, at Lipps Hall, 3rd and W. Highland Avenues. All officers being present. The following officers were elected for the coming year: President, Paul Krause, Vice-President, Robert W. Shaffer, Secretary-Treasurer, Frank J. Marx, Librarian, Henry Binder, Assistant Librarian, Henry Hurtig. Board of Managers, Dan Wittig, Robert Steuernagel and Jack Geissman.

FRANK J. MARX, *Secretary-Treasurer.*

CLEVELAND BRANCH

The May meeting of the Cleveland Branch was held on Saturday evening, May 7, at the offices of the Columbia Electric Co. President E. Steen Thompson called the meeting to order at 8:15 p. m.

We are sorry to report the death on April 18 of our charter member, Mr. E. W. Hale of Akron, who was well known to the older members as "Daddy" Hale. Mr. Hale was 78 years of age and a descendant of Edward Everett Hale. Cleveland Branch will miss him very much.

The following officers were elected for the coming year: President, E. Steen Thompson; Vice-President, H. J. TerDoest; Secretary, H. A. Weber; Librarian, J. S. Nachtman. Board of Managers, J. C. Singler, Fred Luzius, Elmer Peterjohn. Delegates to the Convention, Mr. Thompson, Mr. Nachtman, Mr. Singler, Alternates, Mr. TerDoest, Mr. Stamm.

The business of the meeting being concluded the members went to the shop where they had an opportunity of seeing how the modern generators are made. Mr. Cyrex demonstrated an electric pickle which worked very well. The attendance was very good. PAUL STAMM, *Secretary.*

BOSTON BRANCH

Boston branch met Thursday the 5th at the American House at 8 p. m. with President Gale in the chair.

Communications and bills were read and two new members were elected.

The chairman of the chemistry class will make his final report at the next meeting.

Nomination of officers took place and they will be elected at the next meeting; the following were named: President, Charles O. Hardy; Vice-President, Charles F. Campbell; Secretary-Treasurer, A. W. Garrett; Sergeant At Arms, W. Jones; Board of Managers, Chairman, Bart F. Lee, Fred Mullea and Harry J. Lack, and Librarian, Francis Mackie.

The meeting was turned over to the librarian and he had as the speaker Mr. James Campbell of the Boston Nickel Plating Co., his subject was "Which side of the tank should the rheostat be hooked up to, the negative or the positive pole?"

He gave his reason and explained why it should be hooked up to the negative pole for more than one reason, speaking for more than two hours. He drew an outline on the board of the poles from the tank to the dynamo with the rheostat and ammeter on the negative side showing that he is right. Now this is still an open question in the minds of some of the members and it is the hope of the branch that we will have Mr. Campbell with us again to finish as he says there is a lot more to this question.

Boston branch would like to hear from some of the other branches on this question.

A vote of thanks was given to Mr. Campbell for his very interesting talk.

Meeting adjourned at 11:15 p. m. A. W. GARRETT, *Secretary.*

DETROIT BRANCH

The May meeting of Detroit Branch, held in the Hotel Statler on the 6th, maintained the record made by our Branch in attendance during the last 8 months, and proved to be of more than average interest.

Much interest is manifested in the electro-deposition of tin now, so the educational committee secured papers by two outstanding figures in this branch of plating, namely Mr. R. E. Malder of the Frigidaire Corporation of Dayton, Ohio; and Mr. G. W. Glasson of the Oakland Motor Co. of Pontiac, Mich. Both gentlemen answered numerous questions asked by the interested members, and the hearty applause given them indicated the appreciation of this audience. Both papers are enclosed for publication in the Review.

The Committee expects to have another paper on tin plating and one on alkali zinc plating for the June meeting. We will have a larger room for the next meeting, so we will not be so crowded.

The election of officers resulted as follows: President, Jos. H. Hansjosten; Vice-President, Francis Revell; Secretary-Treasurer, Charles E. Marker; Board of Managers, Chas. Beauhien, W. W. McCord and Geo. Kutzen; Delegates to the convention, Jos. H. Hansjosten, Charles E. Marker and George Kutzen. Acting Librarian, B. F. Lewis.

Owing to the crowded program, the Question Box period was passed over until the next meeting. GEORGE KUTZEN, *Secretary.*

WATERBURY BRANCH

A. E. S. held its regular monthly meeting, Friday, May 13, with President Leroy Miller in the chair.

Communication was received from the By-Law Committee of New York Branch relative to the amendments to be presented at the Philadelphia Convention, and was freely commented on. Favorable action was taken on the communication received from the International Fellowship Club. The annual election of officers resulted as follows: President, Hermant Elwin; Vice-President, Thomas Kane; Secretary-Treasurer; Wm. F. Guilfoile; Librarian, Joseph McConas; Assistant Librarian, Ellsworth Candee; Board of Managers, Wm. Cavanaugh, Wm. Gray and Richard Cuan. Election of delegates to the convention will take place at the June meeting.

SAN FRANCISCO BRANCH

The San Francisco Branch has organized a class in the analysis of plating solutions. This class is being conducted by Mr. Floyd Huntington, graduate of the University of California, at a cost of $0.50 per lesson per member. We have an average enrollment of ten and the classes are being held once a week. Through the courtesy of Mr. Delamothe and Mr. Hibberson the classes are being held in their shops. We are using the "Elementary Course in the Chemical Analysis of Plating Solutions" put out by the Educational Bureau and the outline, a copy of which is enclosed.

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held Saturday, May 14, at the Atlantic Hotel. The meeting was called to order with President J. C. Kretschmer presiding and all officers present.

Our annual election of officers took place and the following were elected unanimously: President, Mr. F. Hanlon; Vice-President, Mr. Gus Jelinek; Secretary-Treasurer, Mr. E. G. Stenberg; Librarian, Mr. O. E. Servis.

There was some race in the officers of the board of managers; after the final count Mr. C. Kocour, F. L. Greenwald and Mr. J. W. Hanlon were elected.

Delegates to the convention are Mr. H. A. Gilbertson, Mr. F. J. Hanlon and Mr. O. E. Servis.

Our old friend and fellow member Mr. Frank Hanlon had a close call Saturday, May 14, when he was hurried to the Norwegian American Hospital. It was found he was suffering from internal hemorrhages but quick action saved his life. We are glad to report that he is rallying under the surgeon's care and will probably be confined to the hospital until June 1.

It is with deep regret that Chicago Branch announces the death of our fellow member, Mr. Chas. Stopper. The members extend their deepest sympathy to his family in their bereavement. We also extend sympathy to our member, Mr. Bob Meyers, in the loss of his father.

The business part of the meeting having been taken care of, the meeting was turned over to the Librarian, Mr. O. E. Servis, and the following questions were found in the Box:

Question.—Will all the galvanizing have to be removed in order to obtain a white finish on the inside of a cup 3 inches in diameter and 2 inches deep? This cup is to be chrome plated.

Answer.—Advise to strip zinc.

Question.—Have any of the members successfully deposited a lead copper alloy? The base metal may be of brass or steel.

Answer.—Other branches please help.

Question.—What effect would sulphur dioxide have on cadmium-plated brass parts?

Answer.—Would have no effect on heavy coating of cadmium.

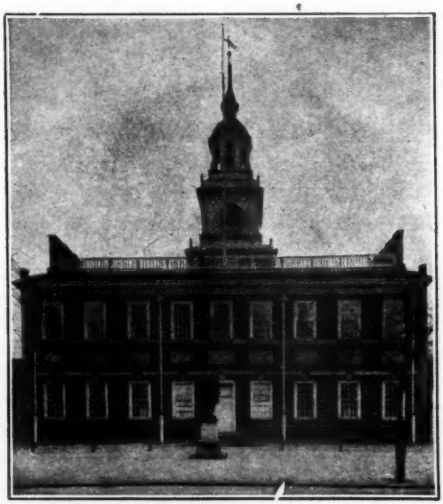
Question.—Which is best resistant coating on steel—Hot galvanizing or electro galvanizing from acid Sol, or from cyanide Sol, tests made in salt spray?

Answer.—Deposts from cyanide sol will stand up longer in salt spray.

Question.—How much tri-valent can be in chrome sol before it is harmful to the throwing power?

Answer.—Reserve answer till June meeting.

E. G. STENBERG, *Secretary.*



Courtesy Conventions and Exhibitions Bureau
Philadelphia Chamber of Commerce

INDEPENDENCE HALL

APPLICATIONS

C. A. CARUSO, 138 Oak Street, Waterbury, Conn.....Bridgeport
M. L. PRESCOTT, 63 Stevens St., Norwalk, Conn.....Bridgeport
H. E. GILLIS, 1220 Bellevue Ave., Elgin, Ill.....Chicago
E. R. FAHY, 323 King Ave., Detroit, Mich. (Assoc.).....Detroit
J. H. JENKINSON, 643 Turner Rd., Walkerville, Ontario (Assoc.) Detroit
N. MOSESIAN, 77 Hamilton Ave., Norwich, Conn.....Hartford
E. A. CUSHING, 917 Cole Ave., Hollywood, Cal.....Los Angeles
C. H. HOWARD, 731 N. Marshall St., Milwaukee, Wis.....Milwaukee
R. SEAMAN, 1255 Morlyn Rd., Overbrook, Philadelphia (Assoc.)
Philadelphia
J. A. STORM, 1044 Third Street, Fullerton, Pa.....Philadelphia
W. SIEBERT, 308 Catherine St., Elmira, N. Y.....Rochester
R. BARDA, 581 Third Street, Richmond, Cal.....San Francisco
N. BISBIGLIA, 2340 Eighth St., Berkeley, Cal.....San Francisco

ELECTIONS

E. C. DELORME, 39 Park Street, Wollaston, Mass.....Boston
W. FRANKLIN, 279 Locust St., Dover, N. H. .....Boston
H. E. GILLIS, 1220 Bellevue Ave., Elgin, Illinois.....Chicago
E. R. FAHY, 323 King Ave., Detroit, Mich. (Assoc.).....Detroit
J. H. JENKINSON, 643 Turner Rd., Walkerville, Ont. (Assoc.) Detroit
N. MOSESIAN, 77 Hamilton Ave., Norwich, Conn.....Hartford
E. A. CUSHING, 917 Cole Ave., Hollywood, Cal.....Los Angeles
R. SEAMAN, 1255 Morlyn Rd., Overbrook, Phila., Pa. (Assoc.)
Philadelphia
W. SIEBERT, 308 Catherine St., Elmira, N. Y.....Rochester
R. BARDA, 581 Third Street, Richmond, California.....San Francisco
N. BISBIGLIA, 2340 Eighth St., Berkeley, Cal.....San Francisco

RESIGNATIONS

H. HAAKE, 4018 Waveland Avenue, Chicago, Ill. .....Chicago
EDW. POWELL, 49 South Third Street, Meriden, Conn.....Bridgeport
A. G. REEVES, Kenwood Madison Company, New York, N. Y.....Bridgeport
W. P. MANNING, 1422 Columbus Ave., Roxbury, Mass.....Boston
C. M. PHILLIPS, 18933 Hickory Street, Detroit, Mich.....Detroit
A. NEUBECK, 4 Parker Ave., Buffalo, N. Y.....Rochester
J. ELDER, Morrow Avenue, Toronto, Ontario, Canada.....Toronto

TRANSFERS

MOORAD MOSESIAN from the Hartford-Connecticut Valley Branch to Boston

DEATHS

W. F. Hickey, 12 Cherry Street, Wallingford, Conn.....Bridgeport
John O'Neill, 1806 Noble Avenue, Bridgeport, Conn.....Bridgeport
J. W. Slattery, Sr., 46 Johnson St., Waterbury, Conn.....Bridgeport
E. W. Hale ("Daddy").....Cleveland
R. H. Bauer.....Philadelphia
C. Wessell, 2115 E. 27th St., Los Angeles, Cal.....Chicago
W. Stopper, 2042 N. Tripp Ave., Chicago, Ill.....Chicago
Geo. Begam, 55 Marvel Rd., New Haven, Conn.....Bridgeport
Fred Flood, 111 Clay Street, New Haven, Conn.....Bridgeport

SUSPENSIONS

A. Walker .....Chicago
W. White .....Chicago
C. Caritas .....Chicago
W. Donnely .....Chicago
H. Alt, R. R. No. 1, South Holland, Illinois.....Chicago
R. Chapman, 3042 N. Racine Ave., Chicago, Ill.....Chicago
J. Chaplik, 4341½ N. Sacramento Ave., Chicago, Ill.....Chicago
W. Glass, 1129 Iowa St., Dubuque, Iowa.....Chicago
B. Keller, 1248 Diversey Parkway, Chicago, Ill.....Chicago
L. Kampelman, 2214 N. Clark St., Chicago, Ill.....Chicago
J. Markett, 148 North 34th Avenue, Chicago, Ill.....Chicago
J. W. Manz, 1141 W. 82nd St., Chicago, Ill. .....Chicago
J. Majerski, 3146 S. Racine Ave., Chicago, Ill.....Chicago
W. Monroe, Grand Hotel, Broadway, Rockford, Ill.....Chicago
C. McKenna, 1025 N. Mason Ave., Chicago, Ill.....Chicago
C. C. Nagel, 1310 Third Ave., Rockford, Ill. .....Chicago
F. Porter, 3904 N. Grove Ave., Western Springs, Ill. .....Chicago
H. Posbeck, 5648 Melrose St., Chicago, Illinois.....Chicago
C. Raine, 909 N. Main St., Abingdon, Ill. .....Chicago
W. Schoenian, 3927 N. Hamilton Ave., Chicago, Ill.....Chicago
G. Wineberg, 1522 W. Austin Ave., Chicago, Ill.....Chicago
F. Yarke, Box 11, Itasca, Illinois.....Chicago

RESEARCH COMMITTEE

Chairman, JACOB HAY.....6920 Ottawa Ave., Chicago, Ill.

Sec.-Treas., WALTER FRAINE.....507 Grand Ave., Dayton, Ohio

S. E. HEDDEN.....227 Fifth Ave., Aspinwall, Penn.

WILLIAM F. GUILFOILE.....14 Oakland St., Waterbury, Conn.

DAN WITTIG.....1221 N. Third St., Milwaukee, Wis.

DR. WILLIAM BLUM.....Bureau of Standards, Washington, D. C.

MR. OSCAR SERVIS.....5305 Warner Ave., Chicago, Ill.

MR. N. E. ZADOWSKI.....1383 W. 65th St., Cleveland, Ohio

MR. W. S. BARROWS.....628 Dovercourt Road, Toronto, Canada

C. F. NIXON.....Ternstedt Manufacturing Co., Detroit

DR. H. S. LUKENS.....University of Pennsylvania, Philadelphia, Pa.

BUREAU OF EDUCATION

Chairman, MR. ALBERT HIRSCH.....1945 Airdrie St., Philadelphia

Branch Representatives:

Chicago Branch.....HAROLD FAINT

Waterbury Branch.....ELLSWORTH CANDEE

Los Angeles Branch.....M. D. RYNKOFS

New York Branch.....HENRY LEVINE

Philadelphia Branch.....DR. A. K. GRAHAM

Baltimore-Washington Branch.....DR. WM. BLUM

Cleveland Branch.....J. C. SINGLER

Hartford-Connecticut Valley.....RAY O'CONNOR

Worcester Branch.....M. H. FROMMANN

Toronto Branch.....C. KEMESH

Anderson Branch.....D. A. COTTON

Newark Branch.....PAUL A. OLDAM

Milwaukee Branch.....HENRY BINDER

St. Louis Branch.....H. H. WILLIAMS

Other Branch Representatives will be printed as received.

ANDERSON BRANCH

Meets first Monday of every month at 7:30 p.m. at the Anderson, Indiana, Y. M. C. A. R. M. Wagner, Secretary-Treasurer, 28 W. 12th St., Anderson, Indiana.

BALTIMORE-WASHINGTON

Meets in Enoch Pratt Library, Calhoun and Hollis Sts., Irvin H. Hahn, Secretary, 207 S. Sharp St., Baltimore, Maryland.

BOSTON

Meets at American House, Boston, Mass. First Thursday each month. Secretary, A. W. Garrett, 100 King St., Dorchester, Mass.

BRIDGEPORT

Meets first and third Friday of each month at Chamber of Commerce Rooms, Stratfield Hotel. Secretary, T. H. Chamberlain, 859 Orange St., New Haven, Conn.

CHICAGO

Meets second Saturday of each month, at 8 p.m., Atlantic Hotel, 316 S. Clark St., Secretary, E. G. Stenberg, 2200 N. Kenneth Ave., Chicago, Ill.

CINCINNATI

Meets every Thursday, 7.30 p.m., at Vocational Training School, Spring and Liberty Sts. Secretary, Al Yeager, 2021 Sherman Ave., Norwood, Ohio.

CLEVELAND

Meets first Saturday of each month at Hotel Winton. Paul R. Stamm, Secretary, 947 Elbon Road, Cleveland Heights, Ohio.

DAYTON

Meets first Saturday of each month at the Y. M. C. A., Dayton, Ohio. Secretary, Ward Protsman, 141 Westwood Ave., Dayton, Ohio.

DETROIT

Meets the first Friday of each month at the Hotel Statler, Louis II Room. Secretary-Treasurer, George Kutzen, 1087 State Fair Ave., West Detroit.

GRAND RAPIDS

Meets second Thursday of each month, 7.30 P. M., at Cody Hotel, 1 Division Avenue, South. Secretary, Jacob Van Dyke, 1361 Union Ave., N. E., Grand Rapids, Mich.

HARTFORD-CONNECTICUT VALLEY

Meets fourth Monday in each month alternately at the Chamber of Commerce, 815 Main St., Hartford, and the Chamber of Commerce, 134 Chestnut St., Springfield. Secretary, Vernon Grant, 32 Jennings Road, Bristol, Conn.

INDIANAPOLIS

Meets second Saturday of each month at Hotel Denison. Secretary, Louis Mertz, 1725 Union St., Indianapolis, Ind.

LOS ANGELES

Meets second Wednesday of each month at the Chamber of Commerce Bldg., 9th floor, 1151 S. Broadway. Secretary, M. D. Rynkofs, 1354 W. 25th St., Los Angeles, Calif.

MILWAUKEE

Meets second and fourth Thursdays of each month at Cor. 3rd and Highland Ave., Frank J. Marx, 1431 W. Cherry St., Milwaukee, Wis.

MONTREAL

Meets second and fourth Friday of e month at 1437 Aylmer St., Montreal, Que Canada, where the Secy-Treas., Mr. Cha Doherty, can be found at any time.

NEWARK

Meets first and third Fridays of e month at Newark Elk's Club, Broad Newark, N. J., at 8 p.m. Secretary-Tre urer, Geo. Rueter, P. O. Box 201, Newa N. J.

NEW YORK

Meets second and fourth Fridays of e month in the World Building, Park R New York City, N. Y. Secretary-Treasur J. E. Sterling, 2540 Steinway St., Asto L. I.

PHILADELPHIA

Meets first Friday of each month in Harrison Laboratory Building, University Pennsylvania, 34th and Spruce Sts. Secreta J. E. Underwood, 327 N. 10th St., Camd N. J.

PITTSBURGH

Meets first Friday of each month at 8 p. at downtown branch, Y. M. C. A. Secreta S. E. Hedden, 227 Fifth St., Aspinwall,

PROVIDENCE-ATTLEBORO

Meets first and third week of each mon Notice by card. J. H. Andrews, Secreta 19 Rosedale St., Providence, R. I.

ROCHESTER

Meets third Friday of each month at Ho Seneca. Secretary, Chas. Griffin, 24 Gar Ave., Rochester, N. Y.

SAN FRANCISCO BRANCH

Meets at Plaza Hotel, San Francis Secretary, H. W. McKibben, 310 Tehama S San Francisco, Cal.

ST. LOUIS

Meets second Friday of each month at t Plant of the Lassaico Co., 2828 LaSalle Secretary, C. T. McGinley, 8214 Fairha Ave., University City, Mo.

TOLEDO

Meets first Thursday of each month Toledo Secor Hotel, Cherry and Page S James M. Lee, Secretary, Barker Street, Fr mont, Ohio.

TORONTO

Meets fourth Monday of each month Canadian Foresters' Hall, 22 College S Room No. 2. Secretary, H. W. Graham, 6 Lauder Ave., Toronto, Canada.

WATERBURY

Meets second Friday of the month Engineers Hall, No. 11 East Main Stree Wm. F. Guilfoile, Secretary, P. O. Box 9 Waterbury, Conn.

WORCESTER

Meets Directors' Room, Chamber of Com merce, Worcester, Mass. Roger H. Bryan Secretary, 94 Grove St., Worcester, Mas